Fig. 1

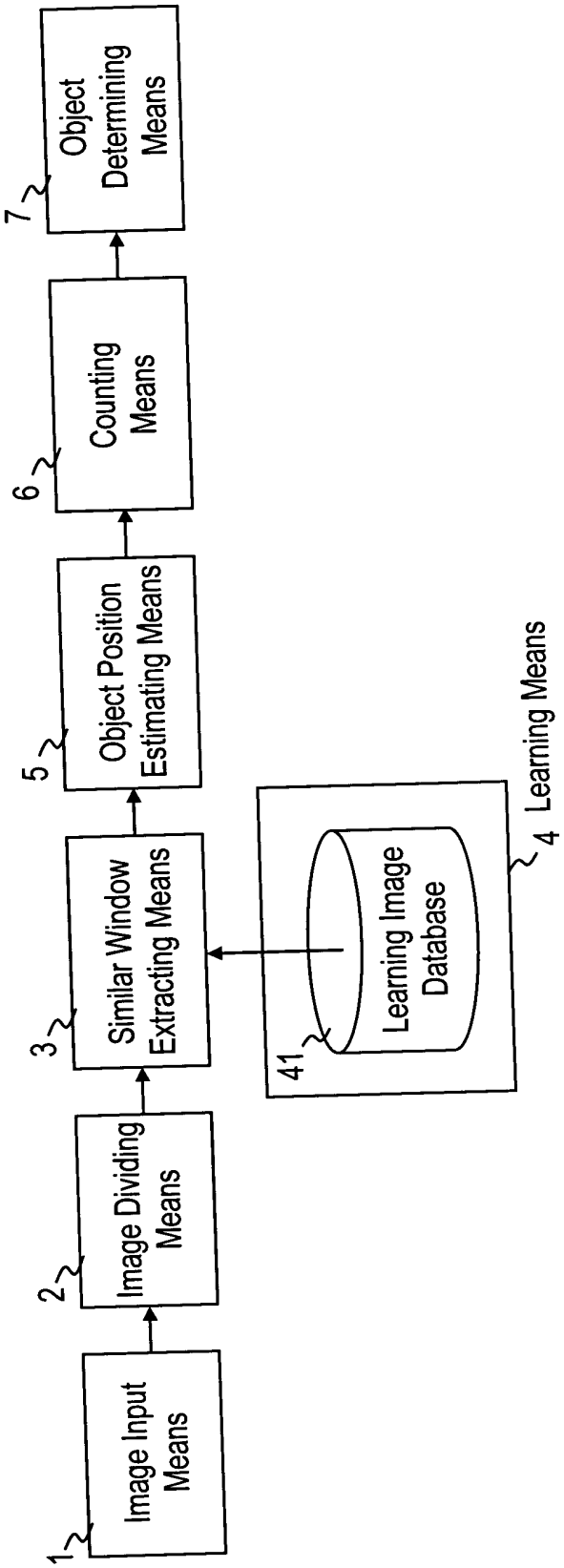


Image Input Means
1
Image Dividing Means
2
Similar Window Extracting Means
3
Learning Means
4
Learning Image Database
41
Object Position Estimating Means
5
Counting Means
6
Object Determining Means
7

Fig. 2

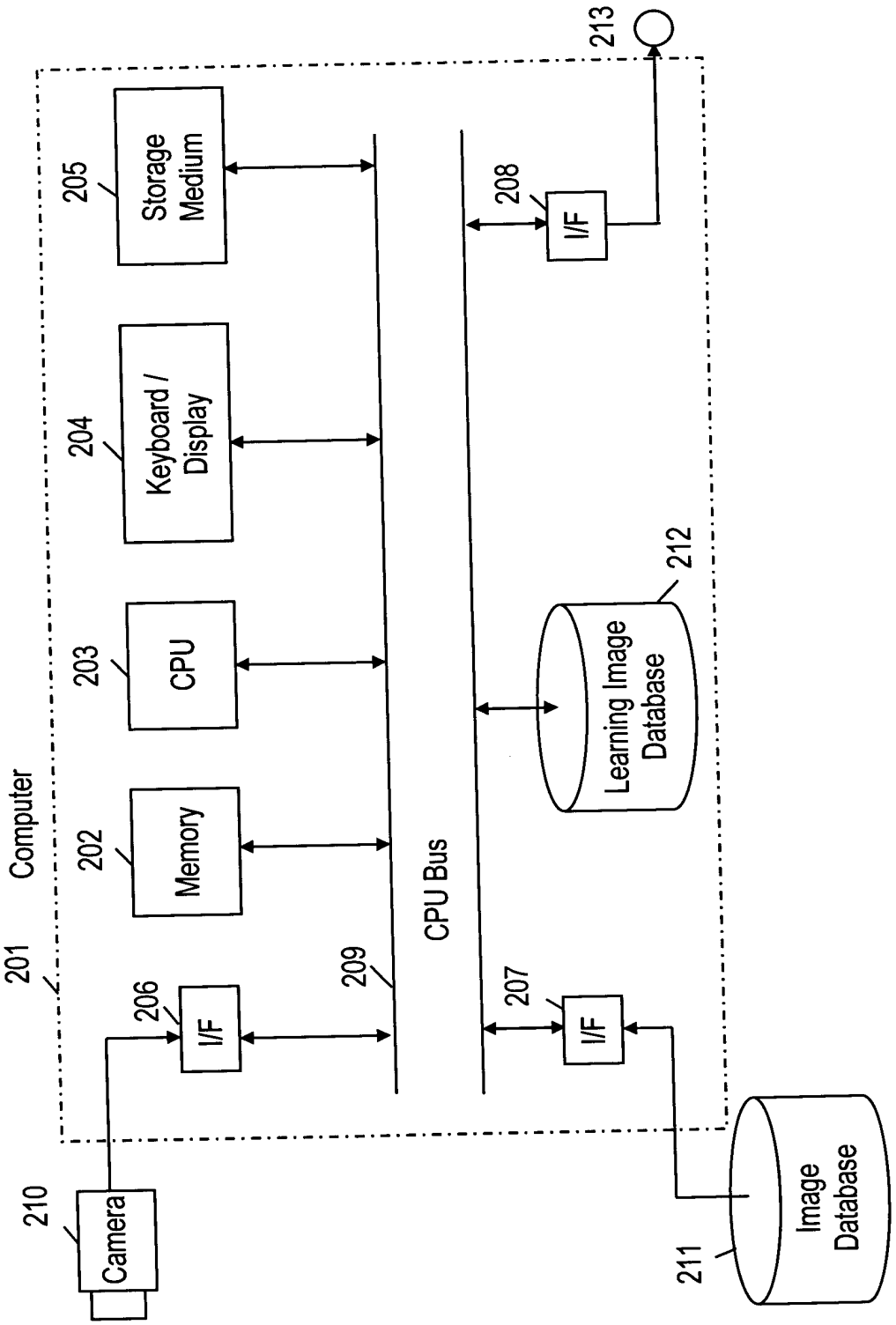

213
205
Storage Medium
208
I/F
204
Keyboard / Display
212
203
CPU
Learning Image Database
202
Memory
Computer
201
CPU Bus
209
206
I/F
207
I/F
210
Camera
211
Image Database

Fig. 3

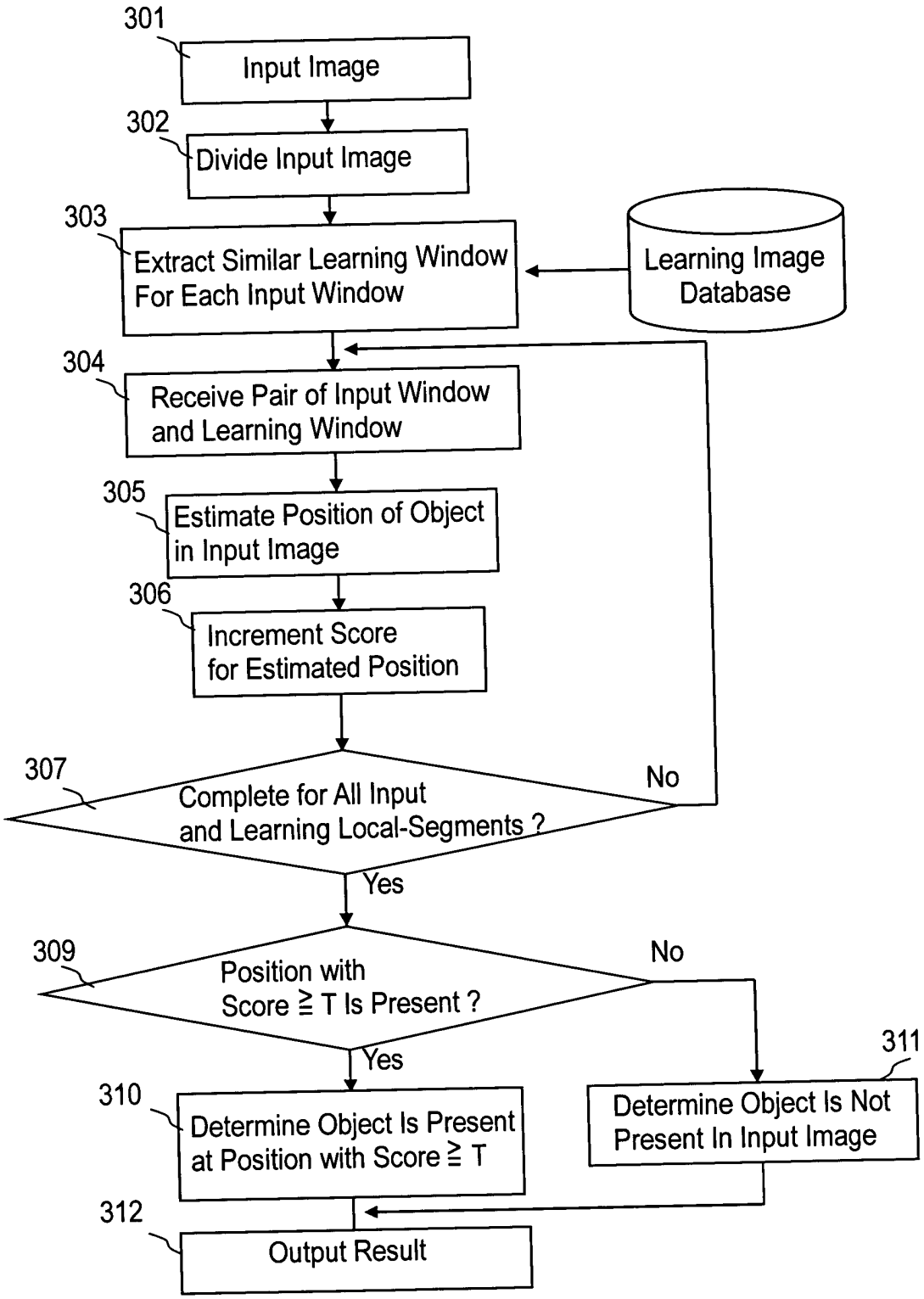

301
Input Image
302
Divide Input Image
303
Extract Similar Learning Window For Each Input Window
Learning Image Database
304
Receive Pair of Input Window and Learning Window
305
Estimate Position of Object in Input Image
306
Increment Score for Estimated Position
307
Complete for All Input and Learning Local-Segments ?
No
Yes
309
Position with Score ≧ T Is Present ?
No
Yes
311
Determine Object Is Not Present In Input Image
310
Determine Object Is Present at Position with Score ≧ T
312
Output Result

Fig. 4

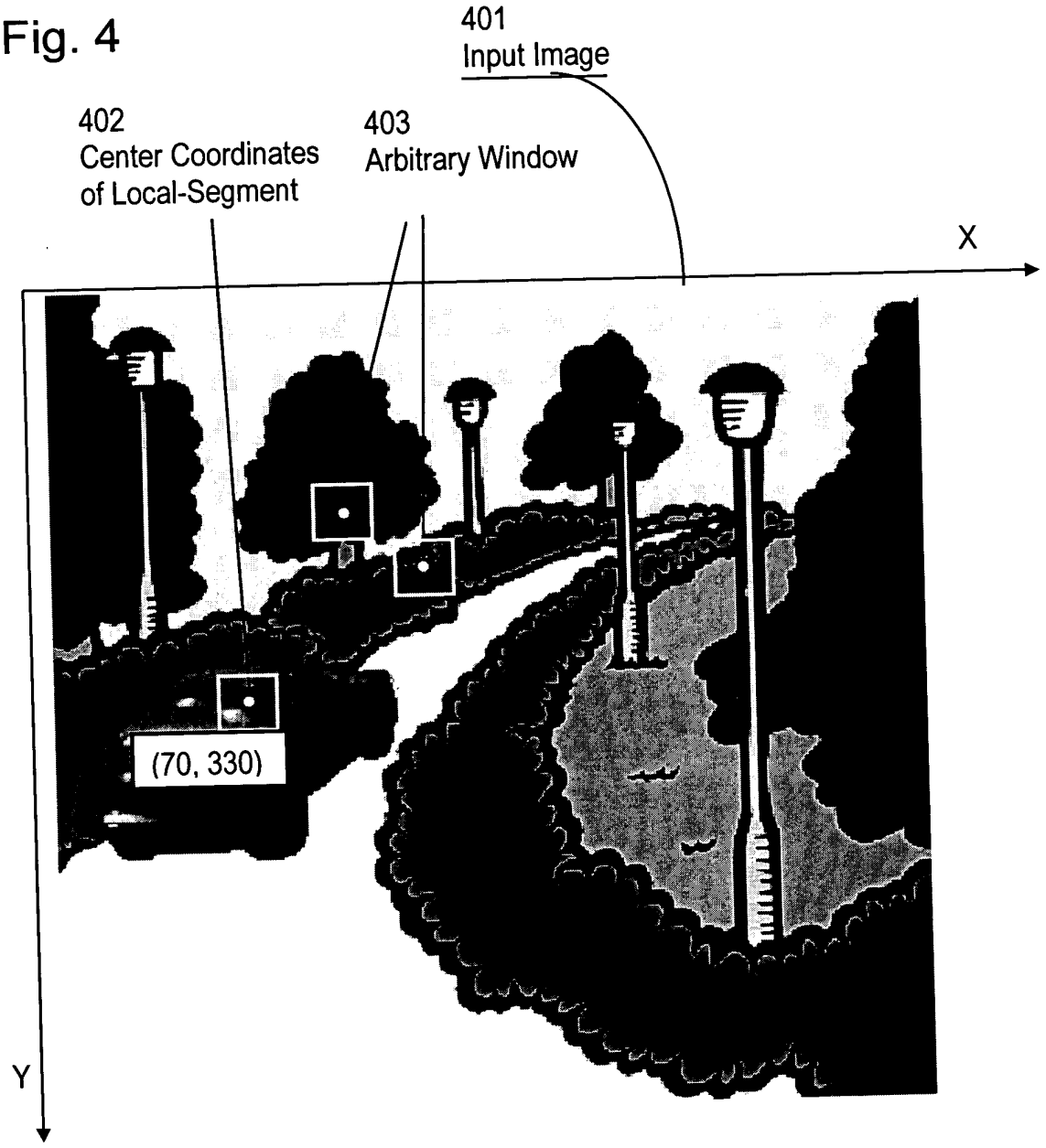

401
Input Image
402
Center Coordinates
of Local-Segment
403
Arbitrary Window
X
Y
(70, 330)

Fig. 5

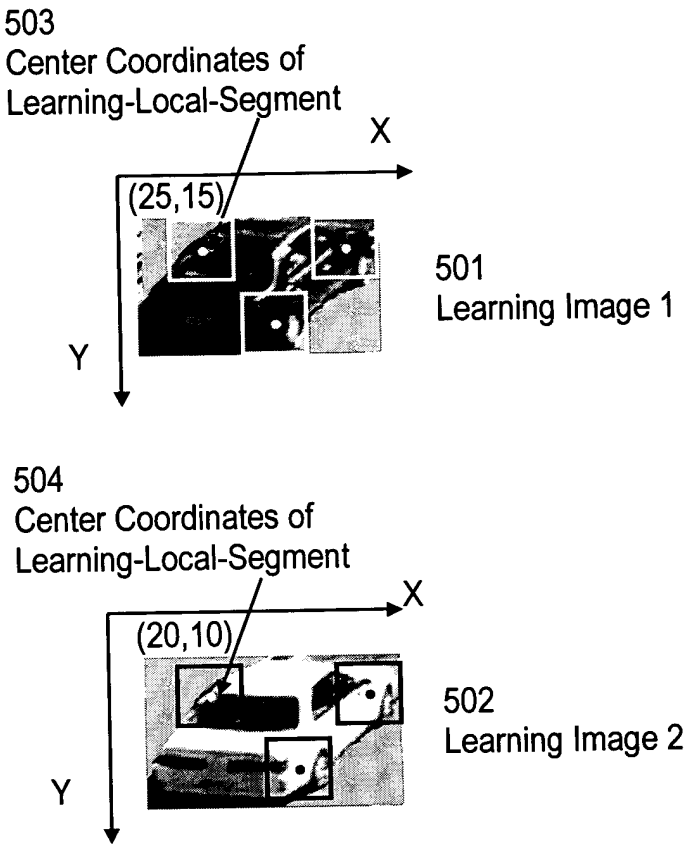

503
Center Coordinates of
Learning-Local-Segment
X
(25,15)
Y
501
Learning Image 1
504
Center Coordinates of
Learning-Local-Segment
X
(20,10)
Y
502
Learning Image 2

Fig. 6

Center Coordinates of Input Window	Center Coordinates of Learning Window
(40, 100)	(75, 365)
(119, 86)	(159, 350)
(198, 72)	(230, 340)
•	•
•	•
(54, 179)	(90, 440)
•	•
•	•
(291, 88)	(225, 345)
•	•
•	•
•	•
•	•
(208, 19)	(240, 280)

Fig. 7

Position	Score
(74, 365)	29
(20, 365)	5
•	•
•	•
•	•
•	•

Fig. 8

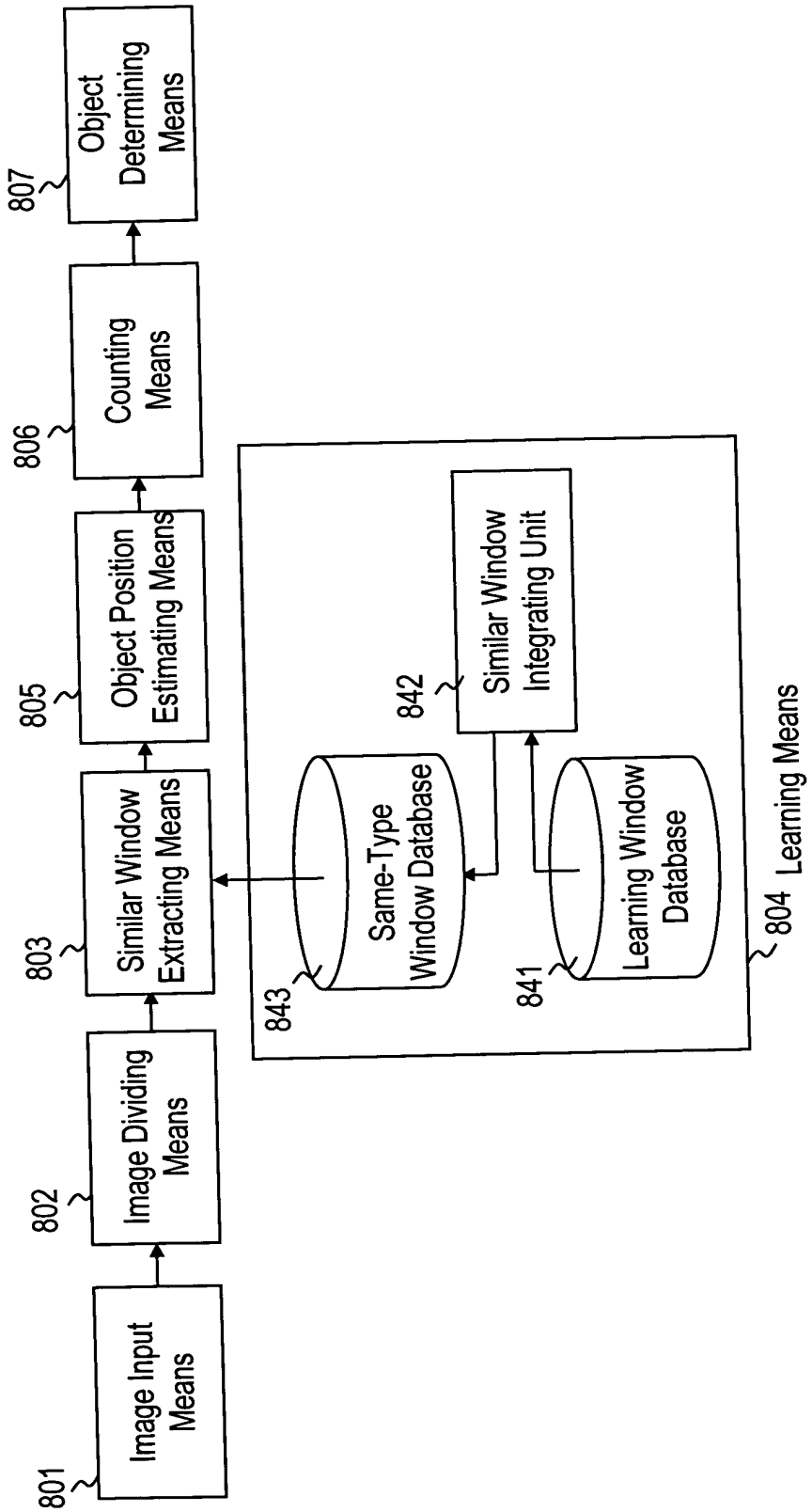

Object Determining Means
807
Counting Means
806
Object Position Estimating Means
805
Similar Window Extracting Means
803
Image Dividing Means
802
Image Input Means
801
Similar Window Integrating Unit
842
Same-Type Window Database
843
Learning Window Database
841
804 Learning Means

Fig. 9

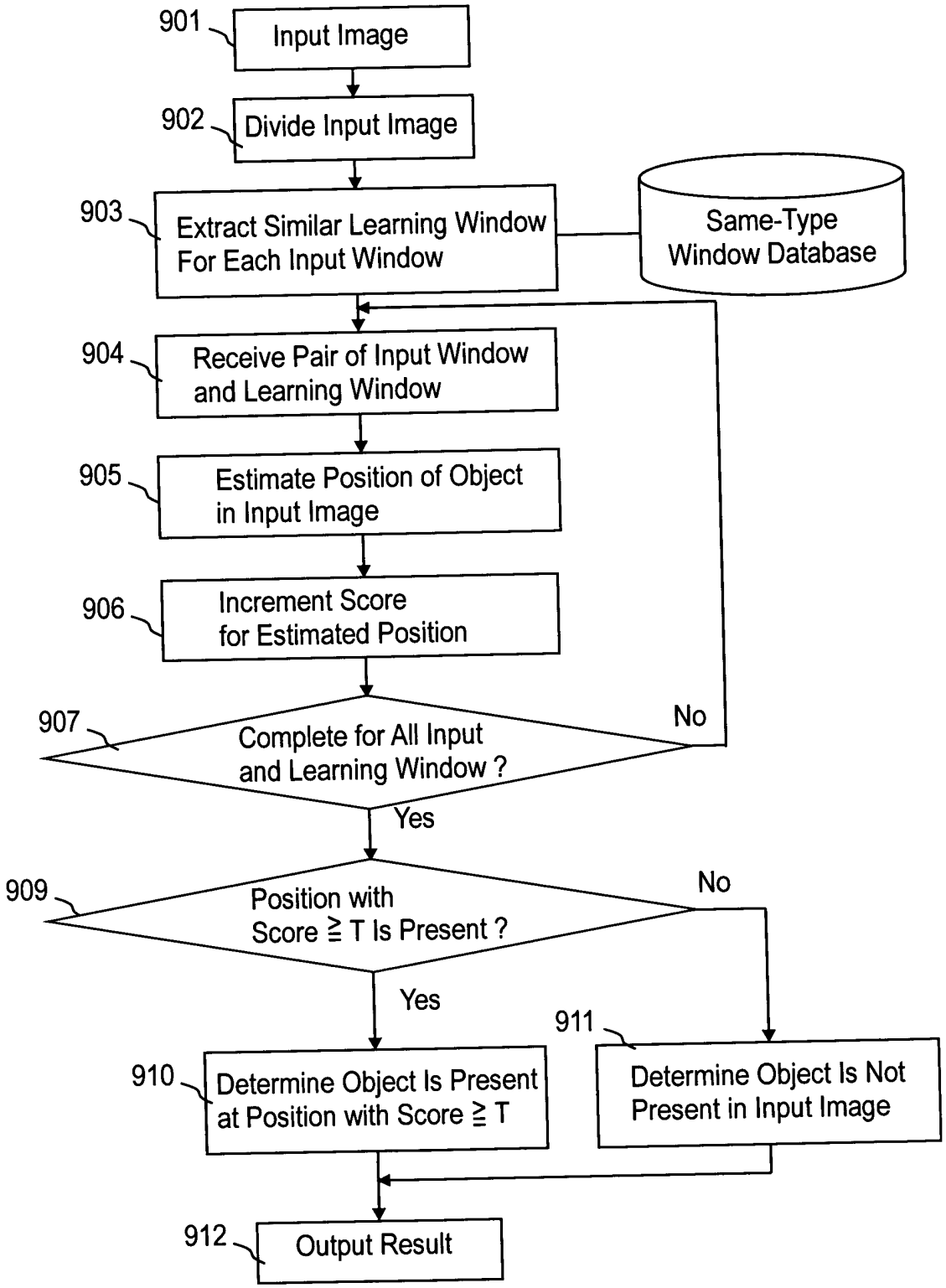

901
Input Image
902
Divide Input Image
903
Extract Similar Learning Window For Each Input Window
Same-Type Window Database
904
Receive Pair of Input Window and Learning Window
905
Estimate Position of Object in Input Image
906
Increment Score for Estimated Position
907
Complete for All Input and Learning Window ?
No
Yes
909
Position with Score ≧ T Is Present ?
No
Yes
910
Determine Object Is Present at Position with Score ≧ T
911
Determine Object Is Not Present in Input Image
912
Output Result

Fig. 10

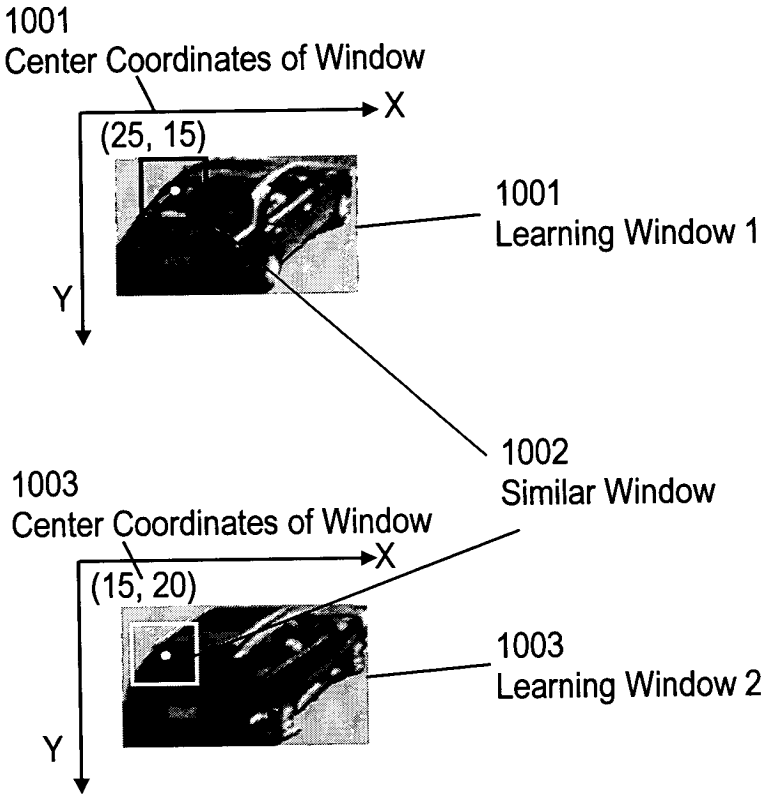

1001
Center Coordinates of Window
X
(25, 15)
Y
1001
Learning Window 1
1002
Similar Window
1003
Center Coordinates of Window
X
(15, 20)
Y
1003
Learning Window 2

Fig. 11

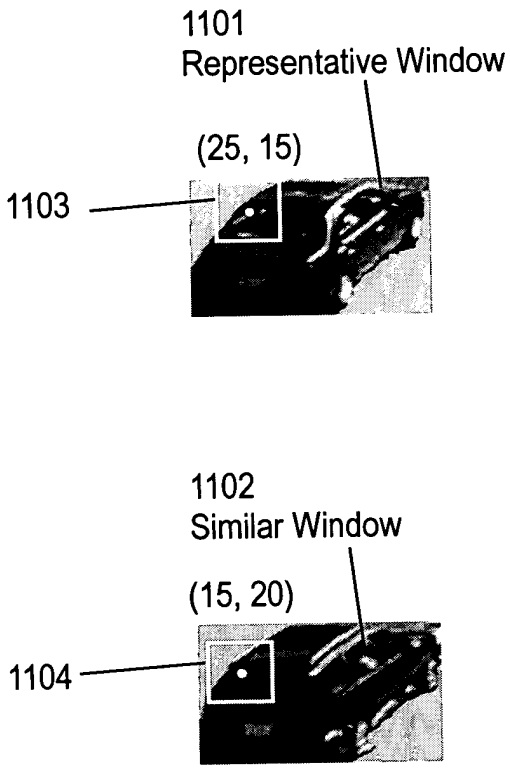

1101
Representative Window
(25, 15)
1103
1102
Similar Window
(15, 20)
1104

Fig. 12

Center Coordinates of Input Window	Center Coordinates of Learning Window	Type of Learning Window
(40, 100)	(75, 365)	Sedan
(40, 100)	(150, 350)	Van
(40, 100)	(230, 340)	Wagon
•	•	•
•	•	•
(24, 178)	(90, 440)	•
•	•	•
•	•	•
(291, 88)	(225, 345)	•
•	•	•
•	•	•
•	•	•
•	•	•
(208, 19)	(240, 280)	

Fig. 13

Position	Score	Score by Type
(74, 365)	29	Sedan : 21, Van : 8
(20, 365)	5	Truck : 3, Bus : 2
•	•	•
•	•	•
•	•	•

Fig. 14

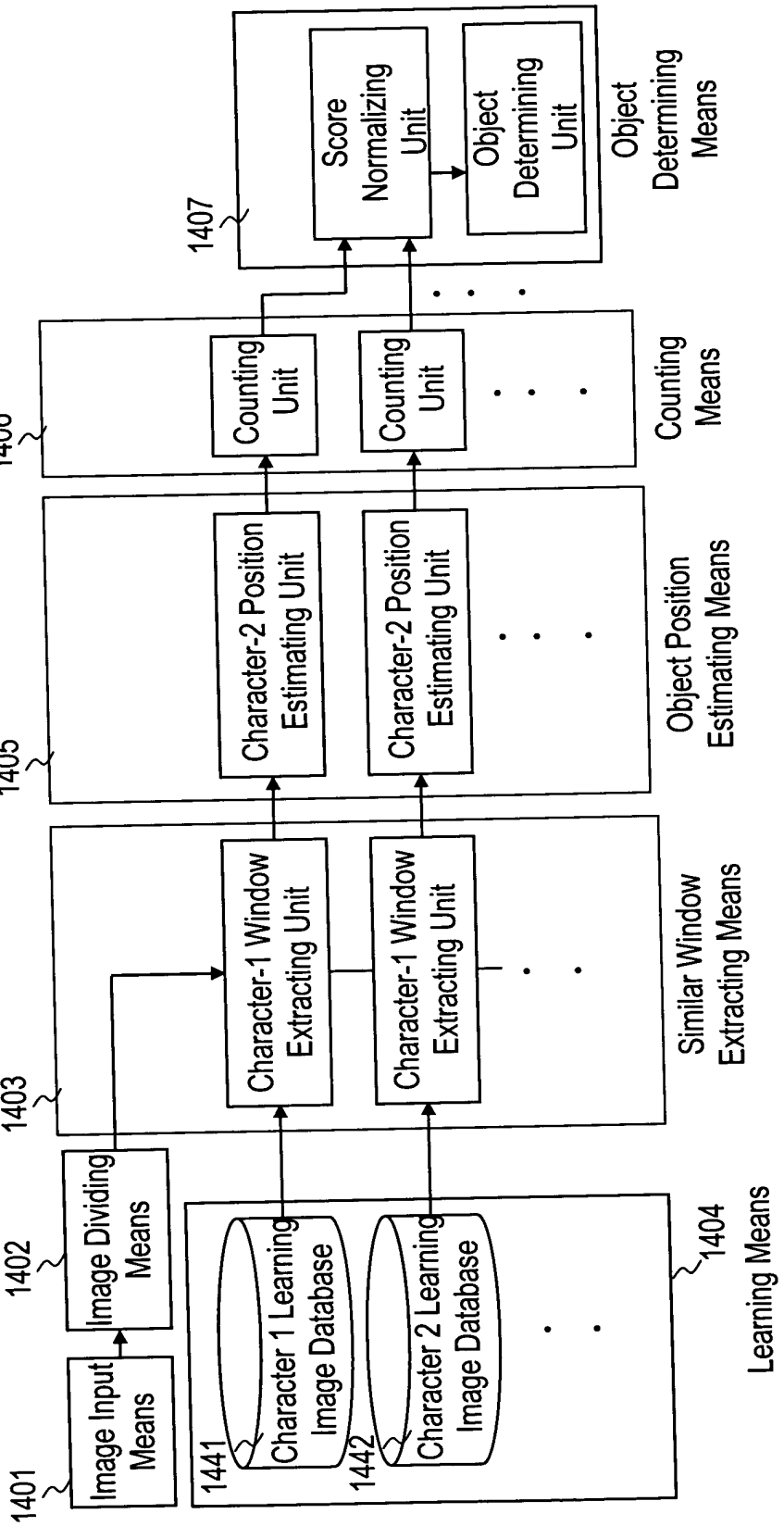

1401
Image Input Means
1402
Image Dividing Means
1403
Character-1 Window Extracting Unit
Character-1 Window Extracting Unit
Similar Window Extracting Means
1404
1441
Character 1 Learning Image Database
1442
Character 2 Learning Image Database
Learning Means
1405
Character-2 Position Estimating Unit
Character-2 Position Estimating Unit
Object Position Estimating Means
1406
Counting Unit
Counting Unit
Counting Means
1407
Score Normalizing Unit
Object Determining Unit
Object Determining Means

Fig. 15

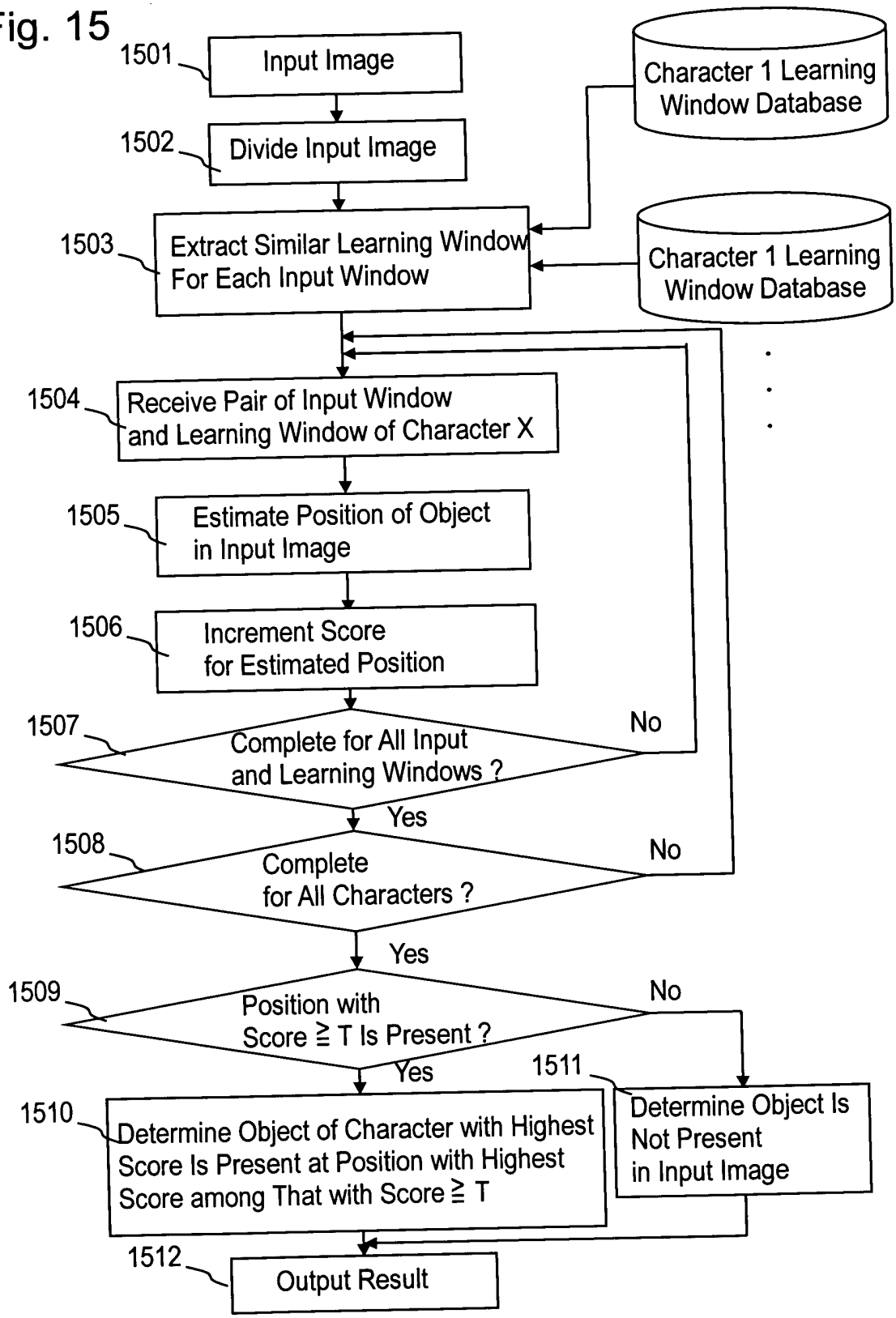

1501
Input Image
1502
Divide Input Image
1503
Extract Similar Learning Window For Each Input Window
Character 1 Learning Window Database
Character 1 Learning Window Database
1504
Receive Pair of Input Window and Learning Window of Character X
1505
Estimate Position of Object in Input Image
1506
Increment Score for Estimated Position
1507
Complete for All Input and Learning Windows ?
No
Yes
1508
Complete for All Characters ?
No
Yes
1509
Position with Score ≧ T Is Present ?
No
Yes
1511
Determine Object Is Not Present in Input Image
1510
Determine Object of Character with Highest Score Is Present at Position with Highest Score among That with Score ≧ T
1512
Output Result

Fig. 16

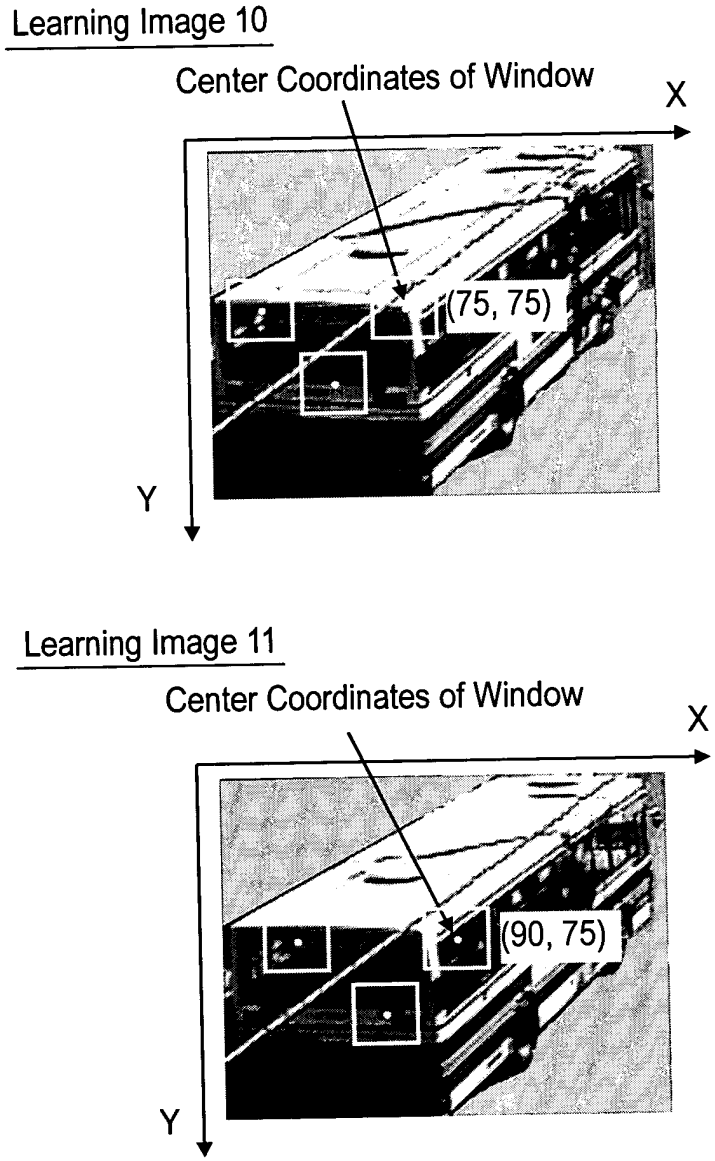

Learning Image 10
Center Coordinates of Window
X
(75, 75)
Y
Learning Image 11
Center Coordinates of Window
X
(90, 75)
Y

Fig. 17

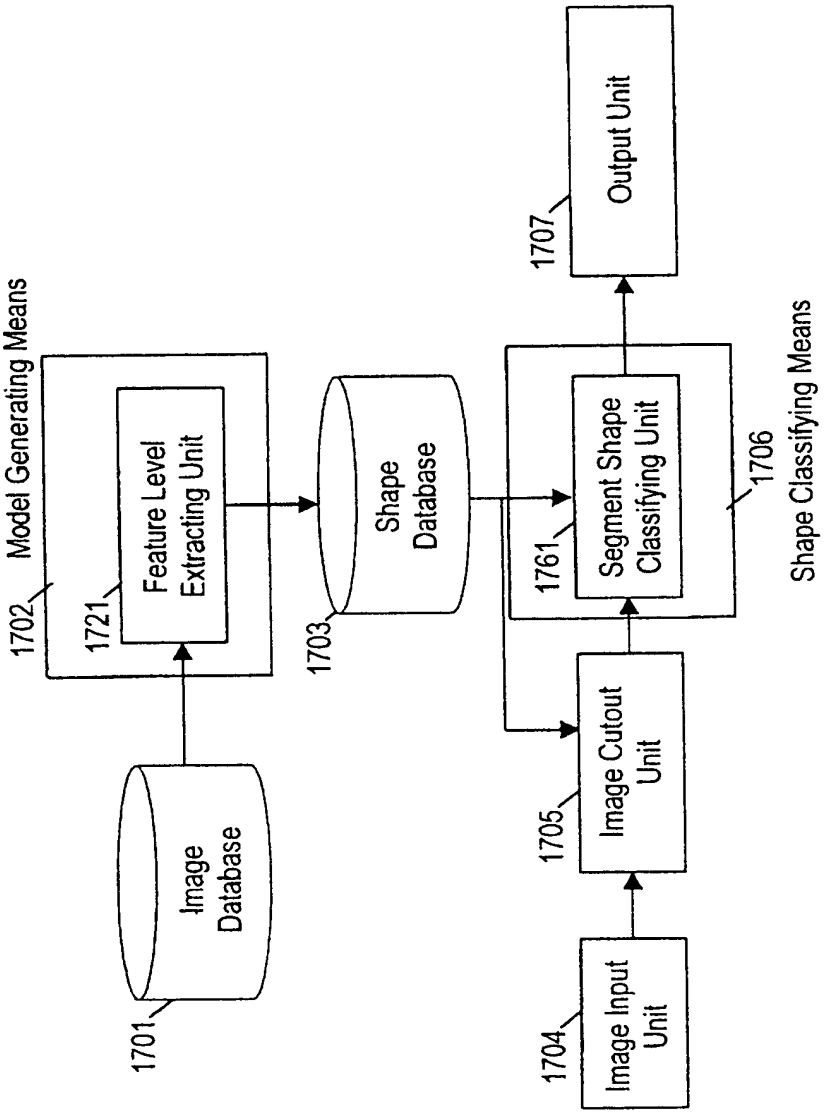

Model Generating Means
1702
Feature Level Extracting Unit
1721
Image Database
1701
Shape Database
1703
Output Unit
1707
Segment Shape Classifying Unit
1761
Shape Classifying Means
1706
Image Cutout Unit
1705
Image Input Unit
1704

Fig. 18

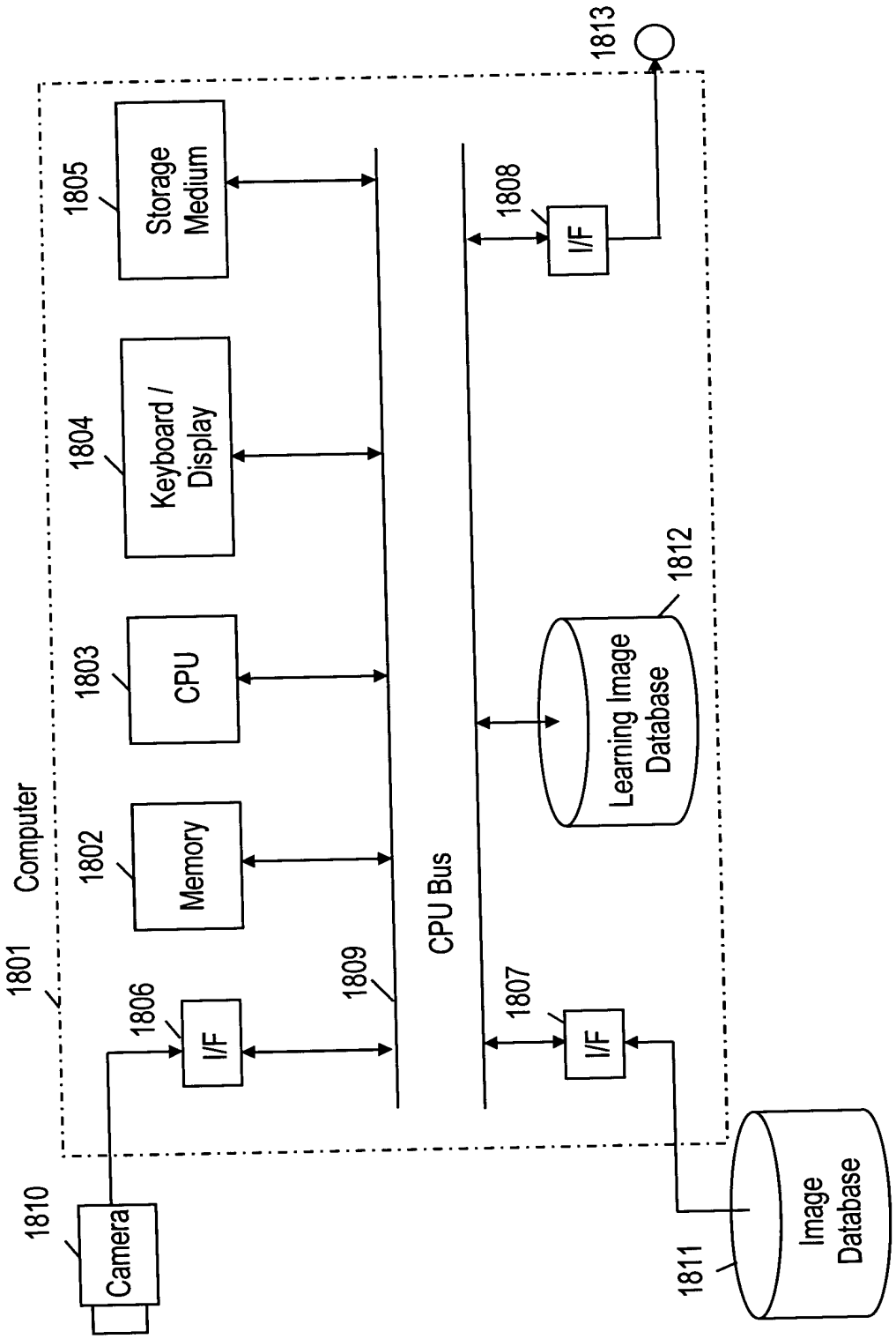

1813
1805
Storage Medium
1808
I/F
1804
Keyboard / Display
1803
CPU
1812
Learning Image Database
1802
Memory
Computer
1801
CPU Bus
1809
1806
I/F
1807
I/F
1810
Camera
1811
Image Database

Fig. 19

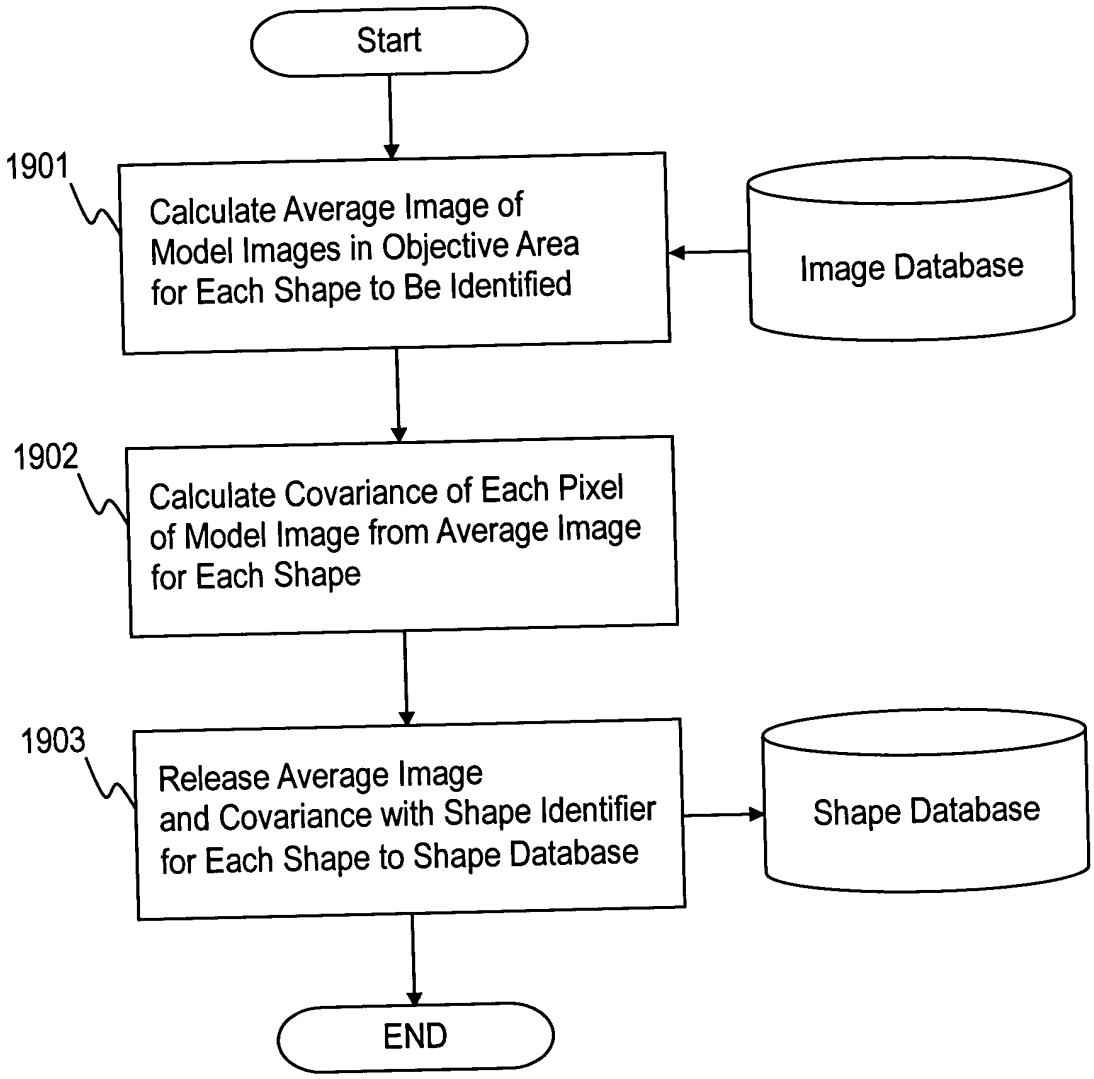

Start
1901
Calculate Average Image of Model Images in Objective Area for Each Shape to Be Identified
Image Database
1902
Calculate Covariance of Each Pixel of Model Image from Average Image for Each Shape
1903
Release Average Image and Covariance with Shape Identifier for Each Shape to Shape Database
Shape Database
END

Fig. 20

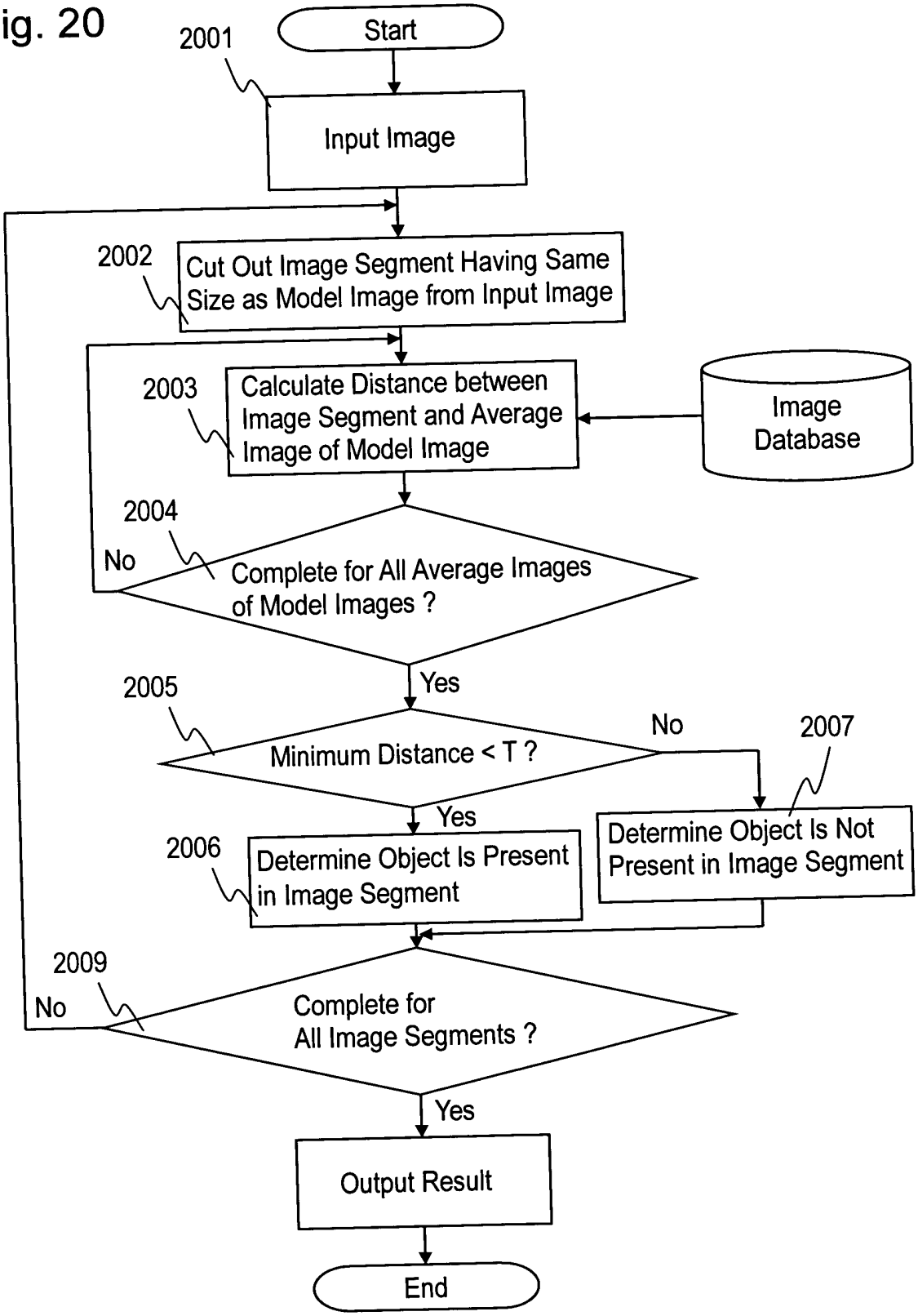

Start
2001
Input Image
2002
Cut Out Image Segment Having Same Size as Model Image from Input Image
2003
Calculate Distance between Image Segment and Average Image of Model Image
Image Database
2004
No
Complete for All Average Images of Model Images ?
Yes
2005
Minimum Distance < T ?
No
2007
Yes
2006
Determine Object Is Present in Image Segment
Determine Object Is Not Present in Image Segment
2009
No
Complete for All Image Segments ?
Yes
Output Result
End

Fig. 21

Shape Identifier :

Shape Name	: Sedan A
Image File Name	: sedan1
Objective Area	: (0, 0) - (147, 87)

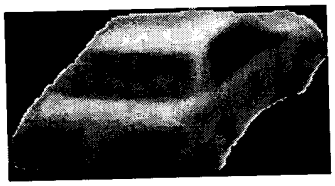
Shape Identifier :

Shape Name	: Sedan A
Image File Name	: sedan2
Objective Area	: (25, 30) - (172, 117)

Shape Identifier :

Shape Name	: Sedan A
Image File Name	: sedan3
Objective Area	: (0, 0) - (147, 87)

Fig. 22



Shape Identifier :

Shape Name	: Sedan A
Image File Name	: average-sedan
Objective Area	: (0, 0) - (147, 87)

Fig. 23

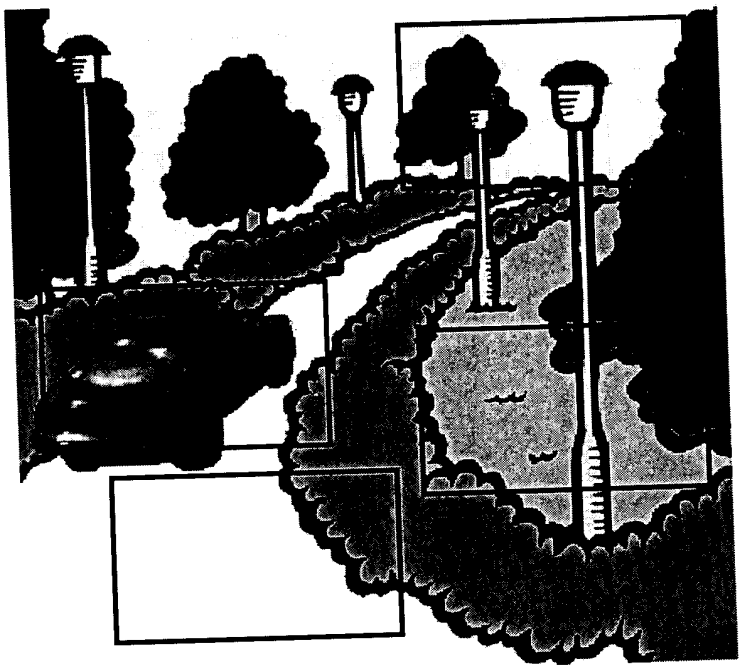


Fig. 24

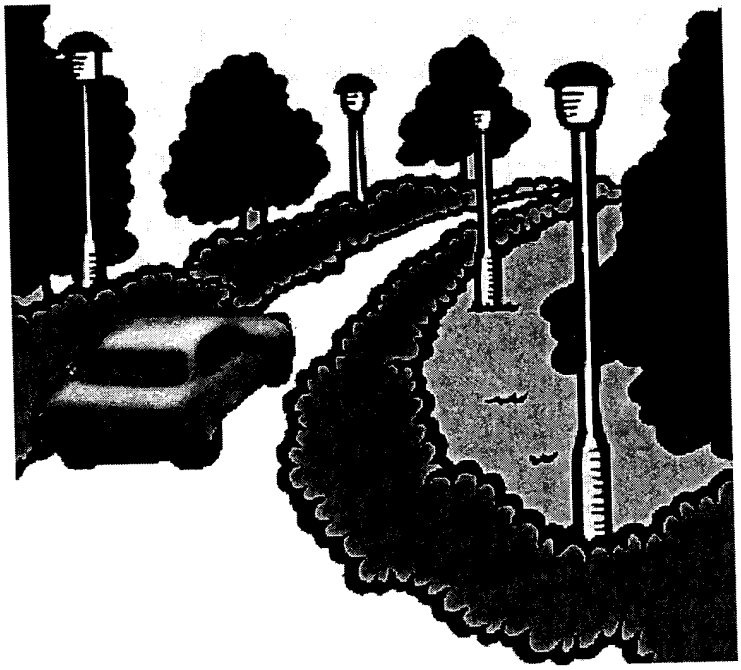


Fig. 25

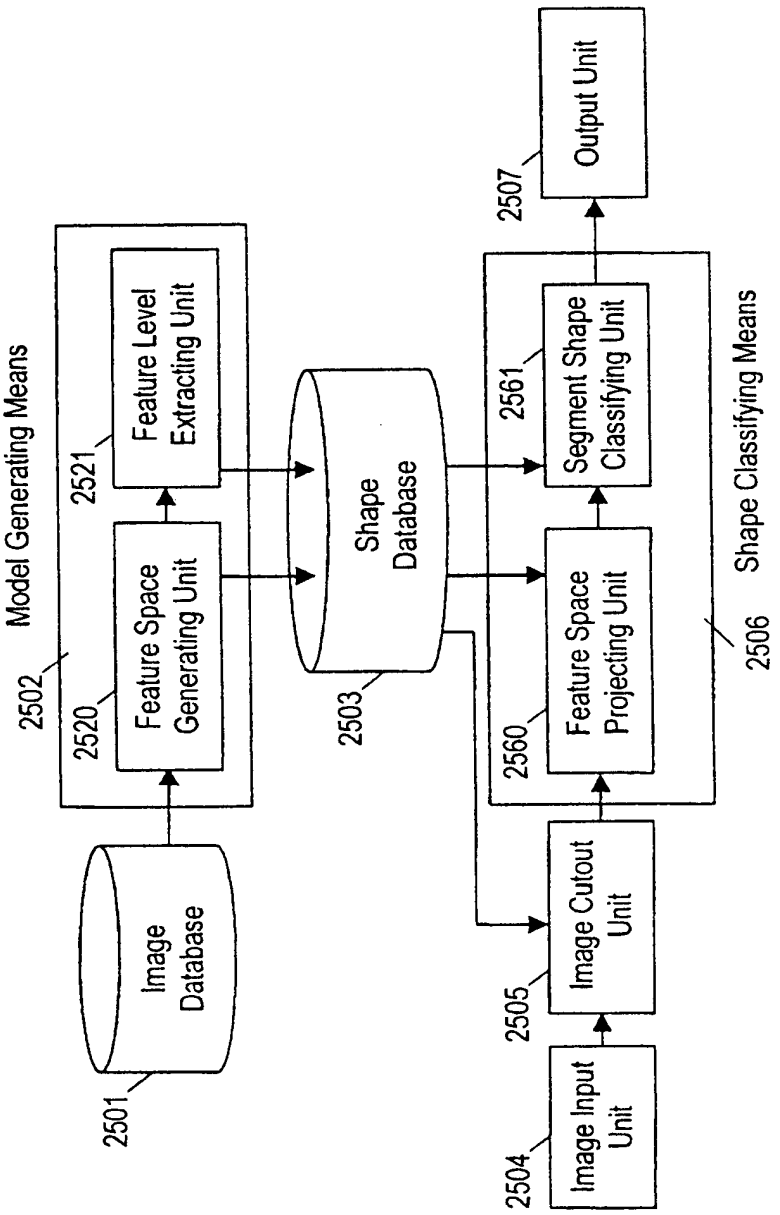

Model Generating Means
2502
Feature Level Extracting Unit
2521
Feature Space Generating Unit
2520
Image Database
2501
Shape Database
2503
Shape Classifying Means
2506
Segment Shape Classifying Unit
2561
Feature Space Projecting Unit
2560
Output Unit
2507
Image Cutout Unit
2505
Image Input Unit
2504

Fig. 26

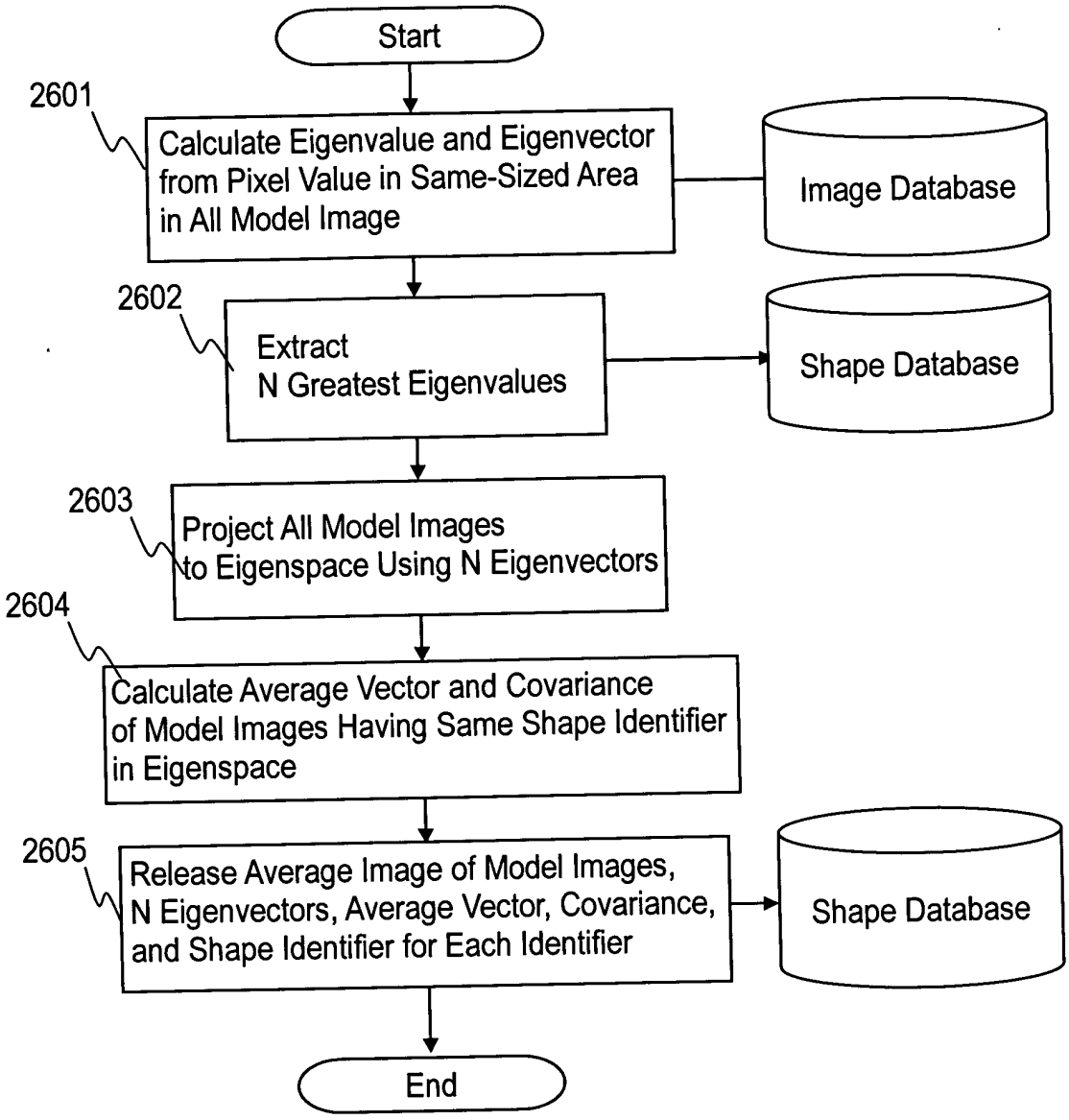

Start
2601
Calculate Eigenvalue and Eigenvector from Pixel Value in Same-Sized Area in All Model Image
Image Database
2602
Extract N Greatest Eigenvalues
Shape Database
2603
Project All Model Images to Eigenspace Using N Eigenvectors
2604
Calculate Average Vector and Covariance of Model Images Having Same Shape Identifier in Eigenspace
2605
Release Average Image of Model Images, N Eigenvectors, Average Vector, Covariance, and Shape Identifier for Each Identifier
Shape Database
End

Fig. 27

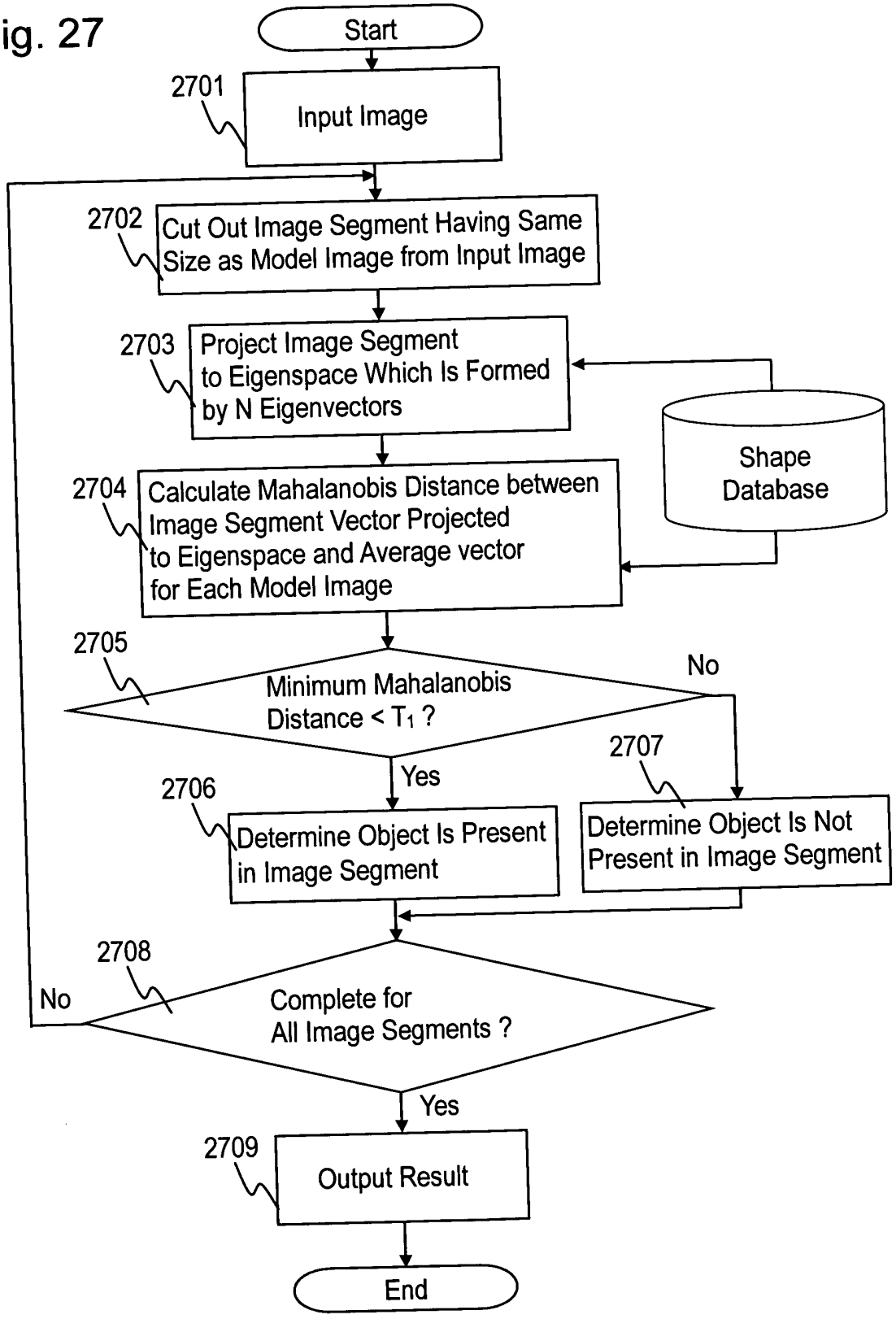
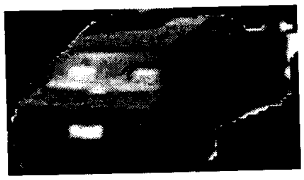
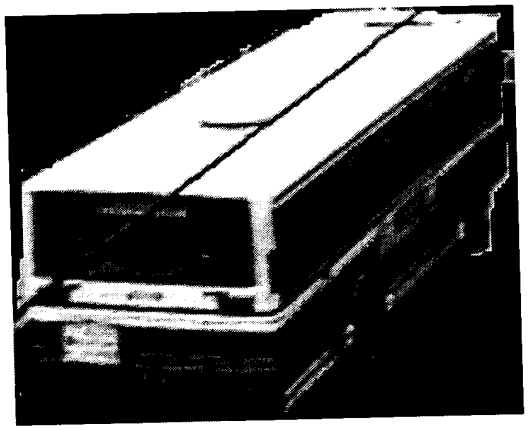

Start
2701
Input Image
2702
Cut Out Image Segment Having Same Size as Model Image from Input Image
2703
Project Image Segment to Eigenspace Which Is Formed by N Eigenvectors
Shape Database
2704
Calculate Mahalanobis Distance between Image Segment Vector Projected to Eigenspace and Average vector for Each Model Image
2705
Minimum Mahalanobis Distance < T_1 ?
No
Yes
2706
Determine Object Is Present in Image Segment
2707
Determine Object Is Not Present in Image Segment
2708
No
Complete for All Image Segments ?
Yes
2709
Output Result
End

Fig. 28



Shape Identifier :

Shape Name	: Sedan A
Image File Name	: sedan1
Objective Area	: (0, 0) - (147, 87)



Shape Identifier :

Shape Name	: Bus Rear Portion
Image File Name	: bus1
Objective Area	: (50, 100) - (197, 187)

Fig. 29

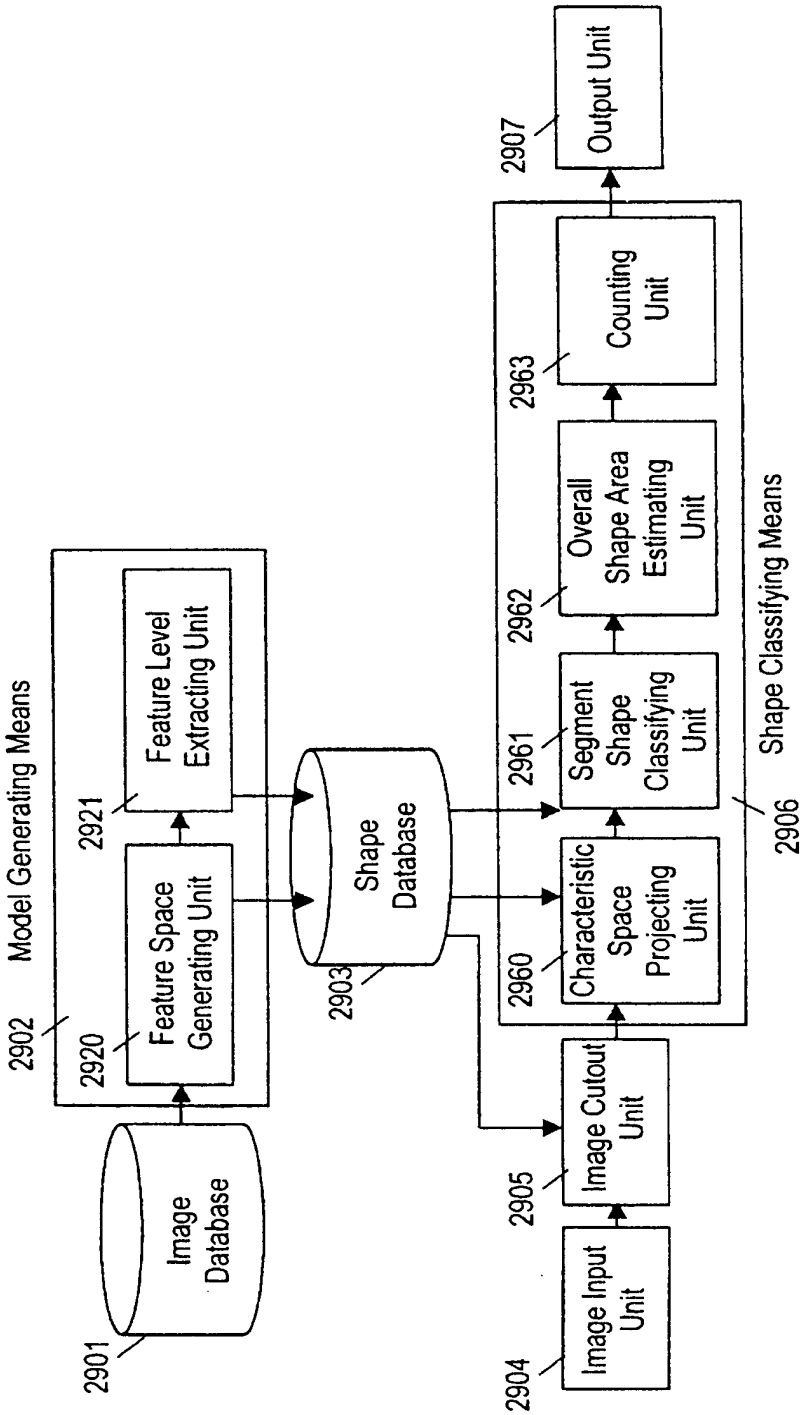

Output Unit
2907
Counting Unit
2963
Overall Shape Area Estimating Unit
2962
Segment Shape Classifying Unit
2961
Characteristic Space Projecting Unit
2960
Shape Classifying Means
2906
Image Cutout Unit
2905
Image Input Unit
2904
Shape Database
2903
Feature Level Extracting Unit
2921
Feature Space Generating Unit
2920
Model Generating Means
2902
Image Database
2901

Fig. 30

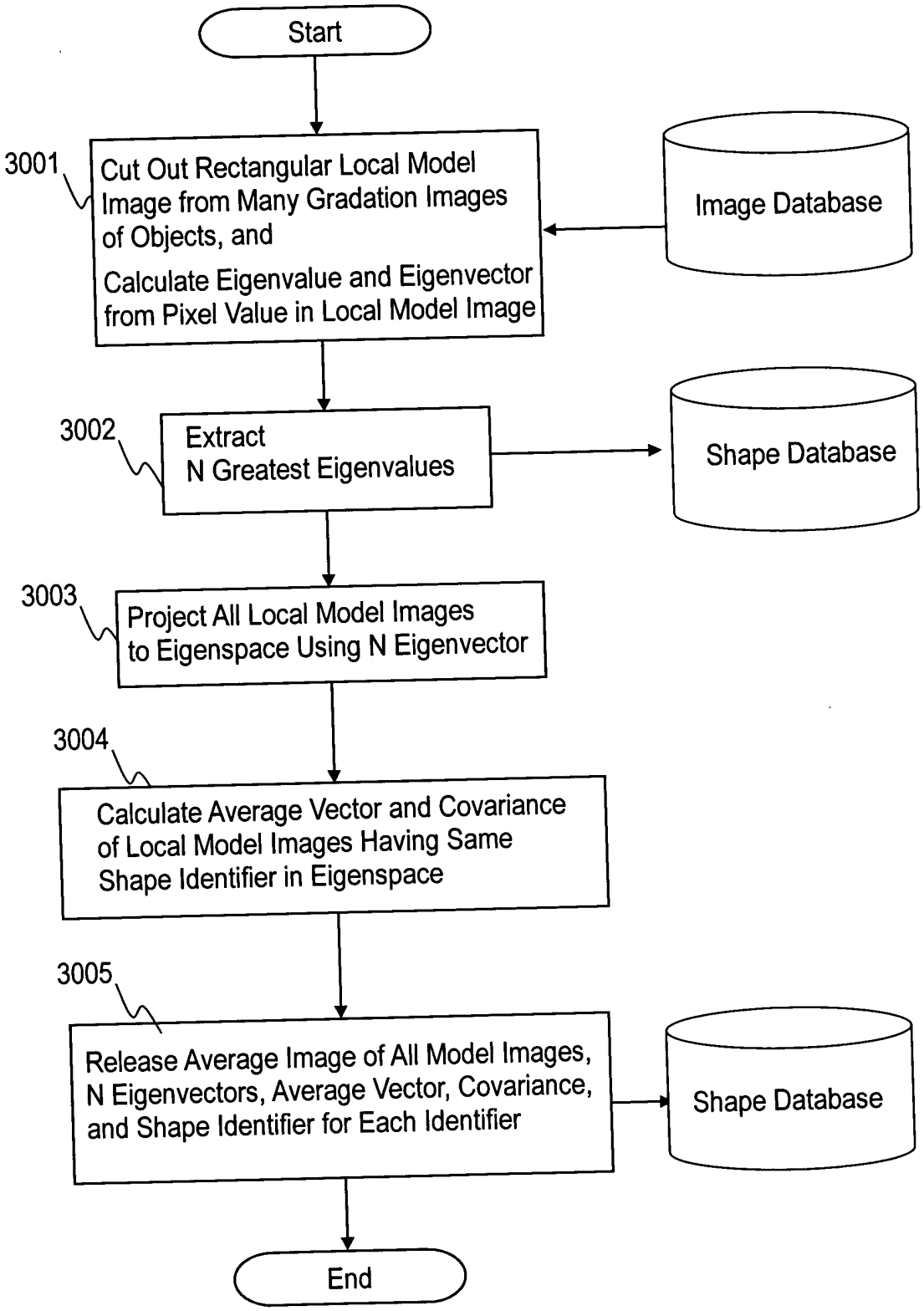

Start
3001
Cut Out Rectangular Local Model Image from Many Gradation Images of Objects, and
Calculate Eigenvalue and Eigenvector from Pixel Value in Local Model Image
Image Database
3002
Extract N Greatest Eigenvalues
Shape Database
3003
Project All Local Model Images to Eigenspace Using N Eigenvector
3004
Calculate Average Vector and Covariance of Local Model Images Having Same Shape Identifier in Eigenspace
3005
Release Average Image of All Model Images, N Eigenvectors, Average Vector, Covariance, and Shape Identifier for Each Identifier
Shape Database
End

Fig. 31

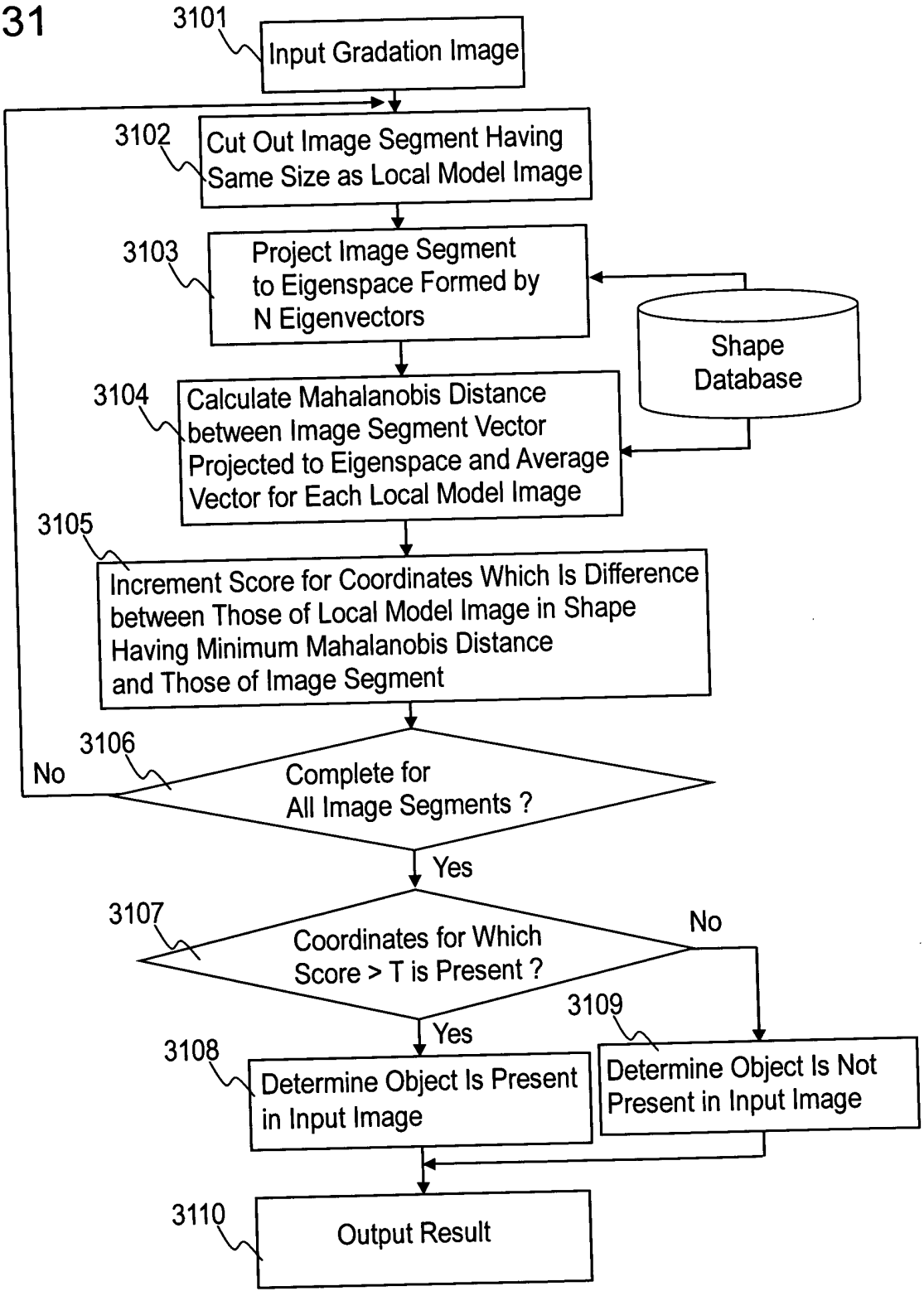
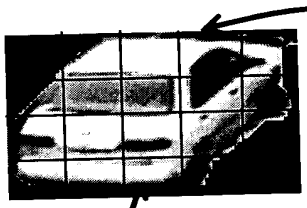

3101
Input Gradation Image
3102
Cut Out Image Segment Having Same Size as Local Model Image
3103
Project Image Segment to Eigenspace Formed by N Eigenvectors
Shape Database
3104
Calculate Mahalanobis Distance between Image Segment Vector Projected to Eigenspace and Average Vector for Each Local Model Image
3105
Increment Score for Coordinates Which Is Difference between Those of Local Model Image in Shape Having Minimum Mahalanobis Distance and Those of Image Segment
3106
Complete for All Image Segments ?
No
Yes
3107
Coordinates for Which Score > T is Present ?
No
Yes
3108
Determine Object Is Present in Input Image
3109
Determine Object Is Not Present in Input Image
3110
Output Result

Fig. 32



Shape Identifier :

Shape Name	: Sedan A-3
Image File Name	: sedan2
Objective Area	: (59, 0) - (87, 21)

Shape Identifier :

Shape Name	: Sedan A-17
Image File Name	: sedan2
Objective Area	: (30, 66) - (58, 87)

Fig. 33

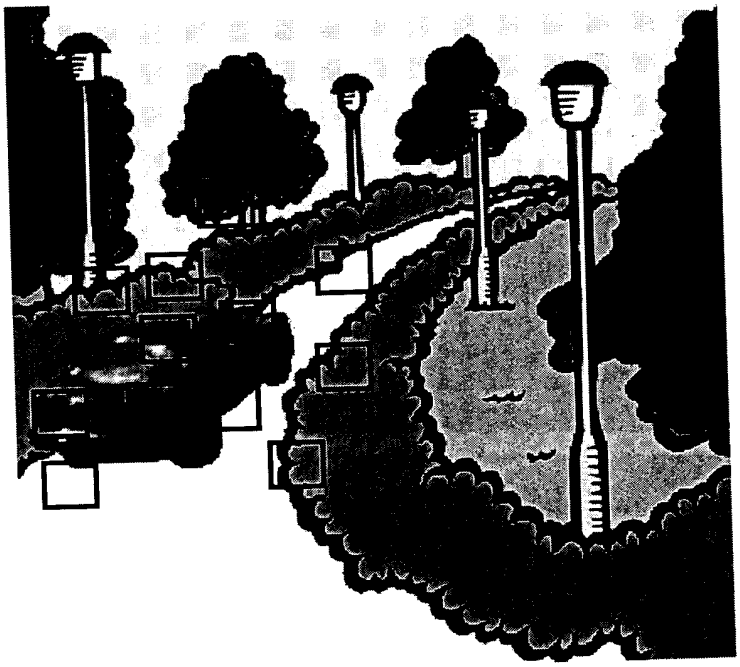


Fig. 34

Position	Score
(74, 365)	29
(20, 365)	5
•	•
•	•
•	•

Fig. 35 Prior Art

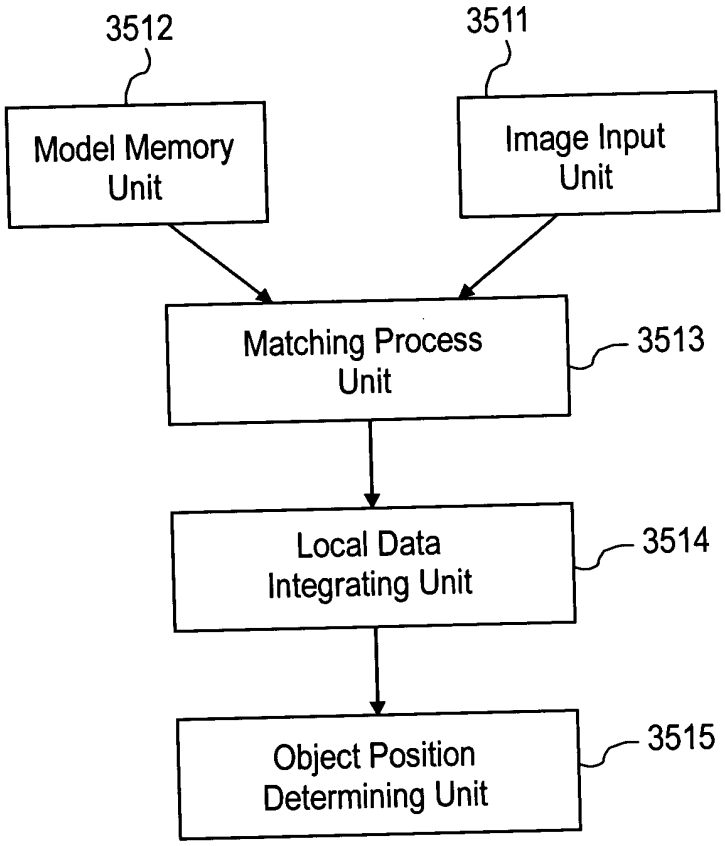
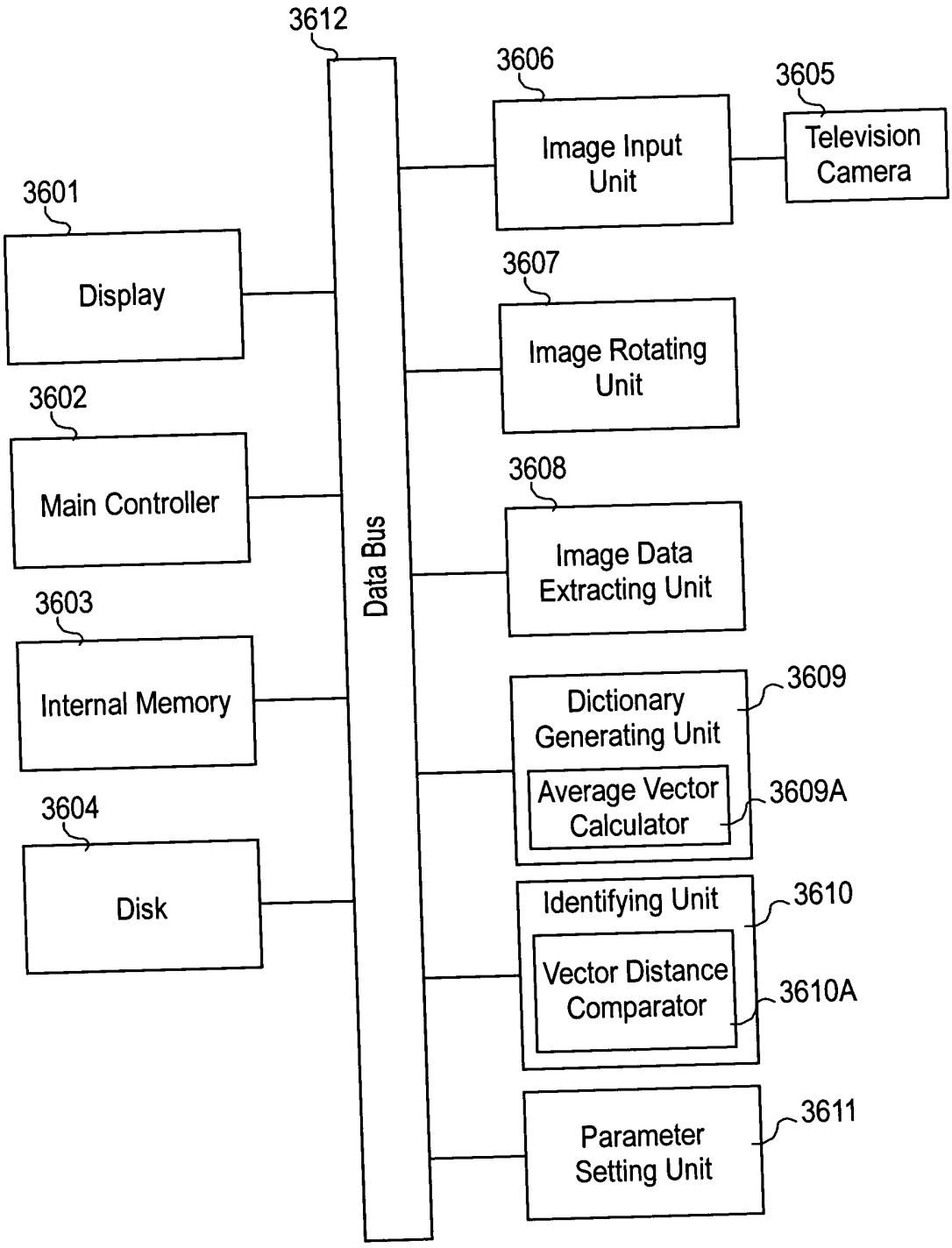


Fig. 36

Prior Art